3:25:5	P.M.	Indicator	bubble	at	100[mg].	Temp.	21.5°C.
3:39:5	"	"	"	"	200	"	20.8
Readjusted.							
3:41	"	"	"	"	0	"	20.8
4.58	"	"	"	"	500	"	19.2 C

Net duration of experiment, 8 hours and 38 minutes; total amount of water used, 3.7 grams. The irregular variations in the forenoon were due to gusts of wind and the repeated opening of the doors.

The leaves showed a superficial extension of 300 [sq cm], including the petioles; area of stem surfaces, 40 [sq cm]. April 16 the leaves were stripped from the shoot, the base of which was trimmed and refitted to the apparatus, and the following observations were made:

10:31	A.M.	Indicator	bubble	at	0[mg].	Tem.	17.5° C.
11:12	"	"	"	"	100	"	18.0
11:43	"	"	"	"	200	"	18.8
12:13	P.M.	"	"	"	300	"	17.5
1:23	"	"	"	"	500	"	16.0
2:00	"	"	"	"	600	"	15.1

The data given above demonstrate the value and accuracy of this method of observation.

Valuable data of the transpiration of winter branches and buds, and opening leaf and flower buds have also been obtained by the use of this instrument.

The apparatus was constructed and calibrated by the mechanics whose services are available to the department.—D. T. MacDougal, *University of Minnesota.*

PARTHENOGENESIS IN MARSILIA.

In February 1896 the writer was led to suspect that some prothallia of *Marsilia Drummondii* which had been grown in the laboratory had developed embryos of considerable size without fertilization having been accomplished in every case. In order to determine whether this was possible, and if so to what size the sporophytes would develop, macrospores were isolated from the microspores before the antheridia matured. Spores were sown on February 13 and February 20. At each time two sporocarps were used. Each was cut on one side to admit water more rapidly, and placed in distilled water in a separate dish. In an hour or two all the sporangia were expelled from the

sporocarps. Within three or four hours after sowing, several macrospores were taken from each lot and passed separately under the microscope to insure that no microspores accompanied them. For this purpose a Leitz objective no. 3 and eyepiece no. 1 were used. The macrospores thus isolated were placed in distilled water in shallow watch glasses and left standing beside the vessels containing the macrospores which were still mixed with microspores.

The spermatozoids matured and were set free about eighteen hours after sowing, and when the specimens were examined twenty-one hours after sowing all the spermatozoids had been discharged. The archegonia on spores from the first and second sporocarps were counted at the end of one day, and the embryos in the same lots were counted and measured at the end of seven days. From the third and fourth sporocarps the embryos were counted at the end of four days. The following tables show the number of spores from which embryos were obtained, the number of spores which produced prothallia but no embryos, and the number which did not develop at all:

SPORES FROM SPOROCARP I.

With spermatozoids				Isolated macrospores			
1 day		7 days		1 day		7 days	
Archegonia	14	Embryos	20	Archegonia	14	Embryos	11
		Sterile prothallia	9			Sterile prothallia	3
Sterile spore	1	Sterile spores	7	Sterile spore	1	Sterile spore	1
	15		36		15		15

SPORES FROM SPOROCARP II.

With spermatozoids				Isolated macrospores			
1 day		7 days		1 day		7 days	
Archegonia	5	Embryos	22	Archegonia	12	Embryos	6
		Sterile prothallia	16			Sterile prothallia	6
Sterile spores	5	Sterile spores	27	Sterile spores	3	Sterile spores	3
	10		65		15		15

SPORES FROM SPOROCARP III, AFTER FOUR DAYS.

With spermatozoids		Isolated macrospores			
		Lot *a*	Lot *b*	Lot *c*	Total
Embryos	8	2	3	5	10
Sterile prothallia	6	5	1	4	10
Sterile spores	21	3	6	1	10
	35	10	10	10	30

SPORES FROM SPOROCARP IV, AFTER FOUR DAYS.

With spermatozoids		Isolated macrospores		
		Lot *a*	Lot *b*	Total
Embryos	19	4	2	6
Sterile prothallia	1	4	6	10
Sterile spores	11	3	2	5
	31	11	10	21

Comparing the prothallia that produced embryos with those that were sterile we find:

	Embryos	Sterile	Total	Per cent. fertile
Sown with microspores	69	32	101	69
Isolated from microspores	33	29	62	53

Briefly stated, over 50 per cent. of the isolated female prothallia produced embryos, while not more than 69 per cent. of those which were mixed with male prothallia produced embryos.

In both cases, at the end of seven days the embryos were of three sorts: (1) those with the root and the cotyledon about equal in length; (2) those with the root less than one-third the length of the cotyledon; and (3) those with no root developed. Those of the first sort from the isolated spores were 10–12^{mm} long, while those of the same sort from the mixed spores were 8–13^{mm} long. Those of the second sort from the isolated and the mixed spores were 4–9^{mm} and 7–9^{mm}, respectively. The embryos of the third sort were 3–7^{mm} long from the

isolated, and 4–6^{mm} long from the mixed spores. The embryos from the mixed spores were slightly larger than the others, and had straighter, whiter roots. The roots of the others turned brown after a time and became crooked and shrunken. The plants were transferred to moist soil in an earthenware saucer, but they did not receive much attention and did not long continue to develop. A few experiments were attempted with other sporocarps, but the material, which had been sent to America from Australia by the Baron von Müller and bore no date, seemed either to be too old or to have dried too young, for most of the spores failed to germinate.

Parthenogenesis, *i. e.*, the development of an unfertilized egg-cell into a plant, has long been known in *Chara crinita*, where it was early observed by De Bary.[1] Lately Klebs[2] has given an account of the germination of the gametes of Ulothrix, Protosiphon, and Spirogyra under certain circumstances without conjugation. The apogamous formation of the cystocarp described by Davis[3] for Batrachospermum and Ptilota is another addition to the allied physiological facts. In none of the higher plants has parthenogenesis been known,[4] though the well known occurrence of apogamy in some of the ferns makes it not surprising to meet with parthenogenesis in this group. If, as the writer's experiments seem to indicate, we really have in Marsilia another example of parthenogenesis, then this plant may afford the cytologist useful material for the study of nuclei in embryos which are developed in this way.—WALTER R. SHAW, *Stanford University*.

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[3] DAVIS, The Fertilization of Batrachospermum. Ann. Bot. **10**:49–76. 1896. —Development of the procarp and cystocarp in the genus Ptilota. BOT. GAZ. **22**: 353–378. 1896.

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